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Title: Diagnostic Capabilities and Techniques of Proton Radiography, Transverse Radiography Emphasis

Author(s): Hollander, Brian J.

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Los Alamos
NATIONAL LABORATORY
EST.1943

Diagnostic Capabilities and Techniques of Proton Radiography

Transverse Radiography Emphasis

NSTec pRad Project Review

6 February 2014

B.J. Hollander for the pRad Team

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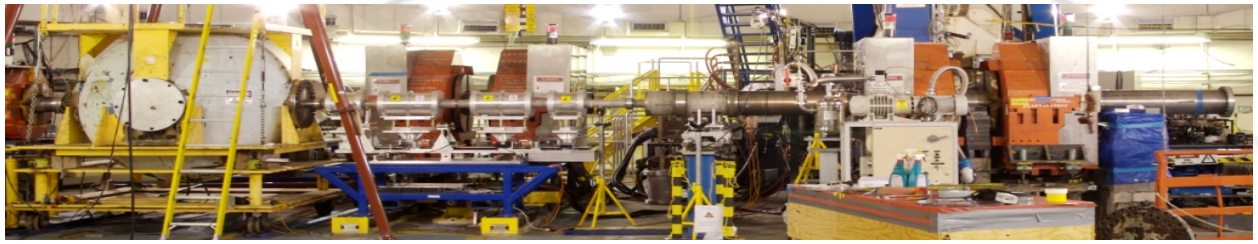
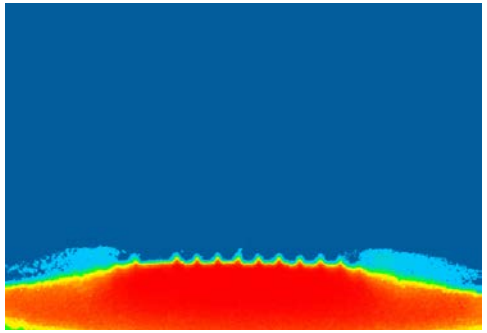
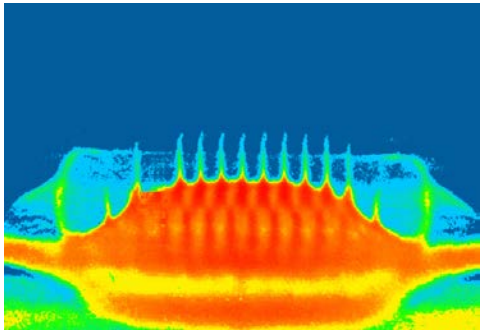
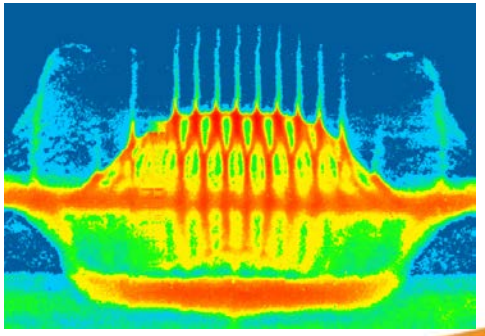
pRad Overview



- Collaborators
  - P, WX, XCP, XTD, AOT, LANSCE, MST, W & NSTec
- General pRad capability
  - Uniqueness to adapt secondary diagnostics







Key Points

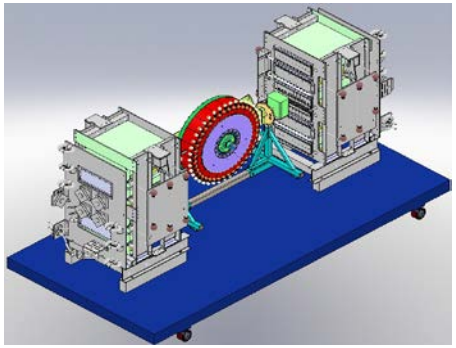
- Developed techniques and secondary diagnostic capability overview
- pRad X-Ray history and intent
- Soft X-Ray discussion and future

Developed Techniques

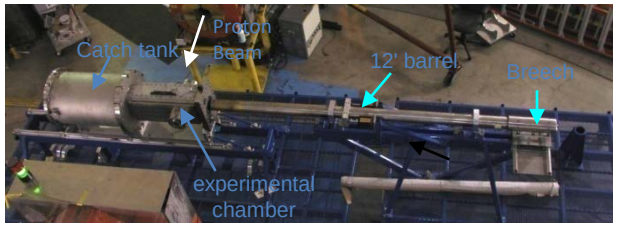
- Unique ability to integrate secondary diagnostics without impact

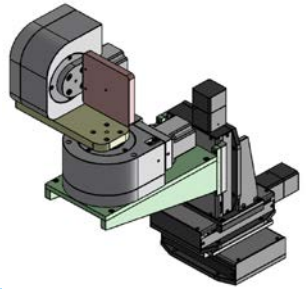
New techniques developed for use at pRad

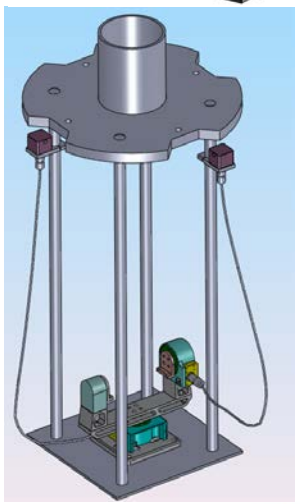
PHELIX



40mm Powder Gun



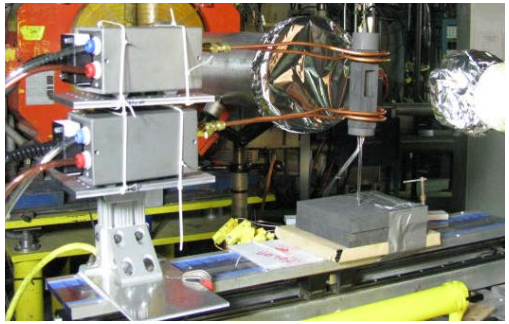




Goniometer

MOXIE Continuous Imager

Solidification



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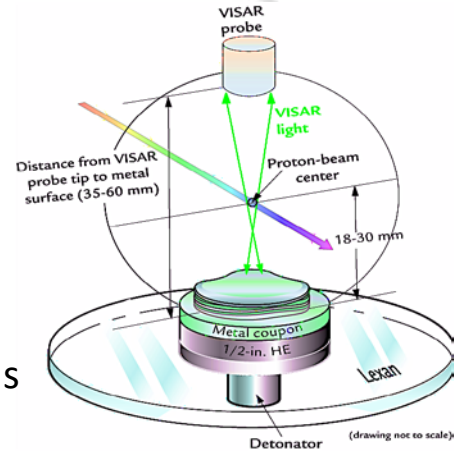
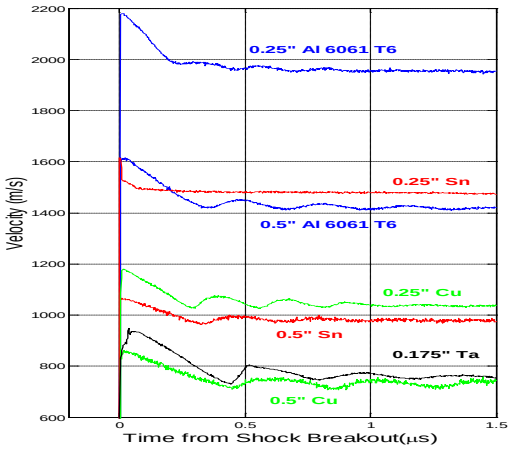
Secondary Diagnostics

Current diagnostic suite

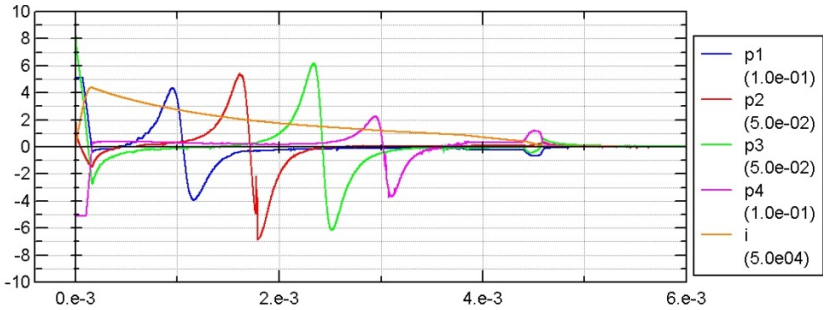
- 8 Channels 13GHz PDV
- 7 Channels Single Leg Visar
- 1 Channel Two Leg Fast Visar
- 28 Points Dual Coverage Pins
  - Shorting, Piezo, and Ionization Pins
- Foil switches

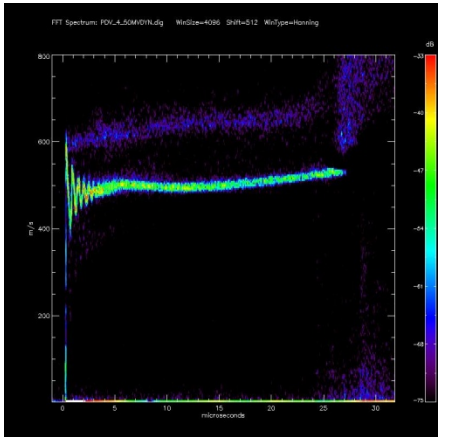




Previously fielded at pRad

- Shadowgraphy
- B-Dots
- I-Dots
- Structured Light
- Spectroscopy
- X-Rays





pRad X-Ray History and Intent

- 2008
  - Began identifying new potential diagnostics for pRad
    - An orthogonal X-Ray diagnostic would be ideal to compliment pRad
    - Started research to determine an energy source comparable to pRad
    - A Cygnus-like machine was deemed to be sufficient
- 2009
  - Research advancement directive through P Division office
    - Conduct feasibility studies to integrate a Cygnus source at the pRad facility
    - The cost was significant with and without the removal of the HRS
  - Submitted proposal for funding of Tri-MeV
    - LDRD Matters in Extreme proposal was unsuccessful
    - The program office decided to fund the Tri-Mev effort
    - Fabricated vessel doors and started integration process

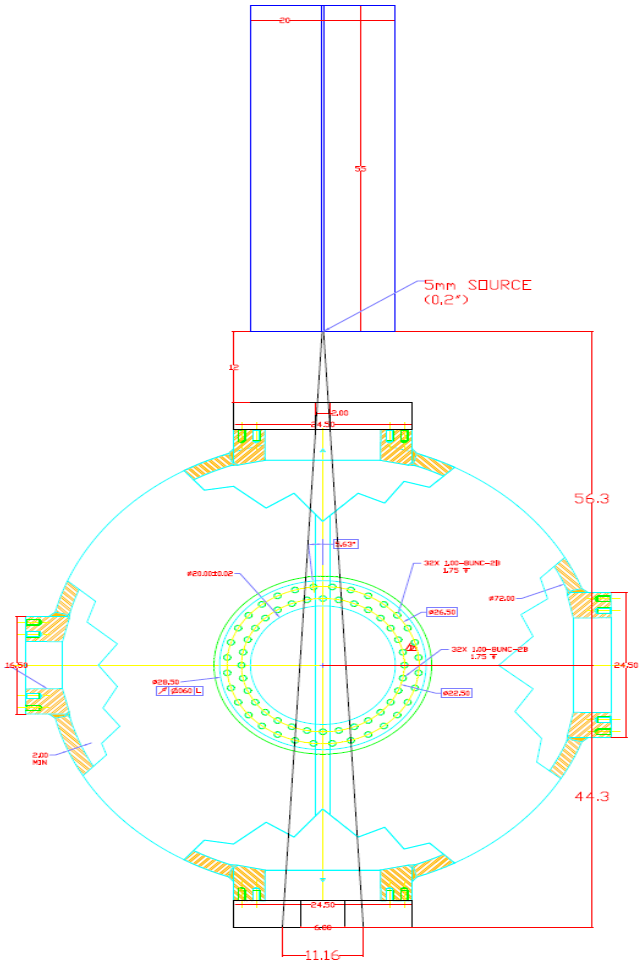
pRad X-Ray History and Intent

- 2010
  - Logistics
    - Used lower energy sources to help identify issues
    - Organized effort to relocate Tri-MeV
    - Scheduled proof testing with new doors
  - The X-Ray integration gained a lot of attention
    - Science and technology workshop focused on comparable X-Ray methods
    - The cost to relocate Tri-MeV more than doubled
    - Program office would not fund at the new level
- 2012
  - LDRD
    - Realized we were not going to acquire funding for LTD or Cygnus
    - Tri-MeV was allocated elsewhere

Vessel Configuration

BIRD'S-EYE VIEW OF PRAD VESSEL 6-2-5-1 (A537 6-FOOT 5-PORT 2-INCH-THICK)

Shown: 1-foot stand-off distance from source to upstream door



p
+

2-inch aperture in upstream door

p
+

IL1

6-inch aperture in downstream door

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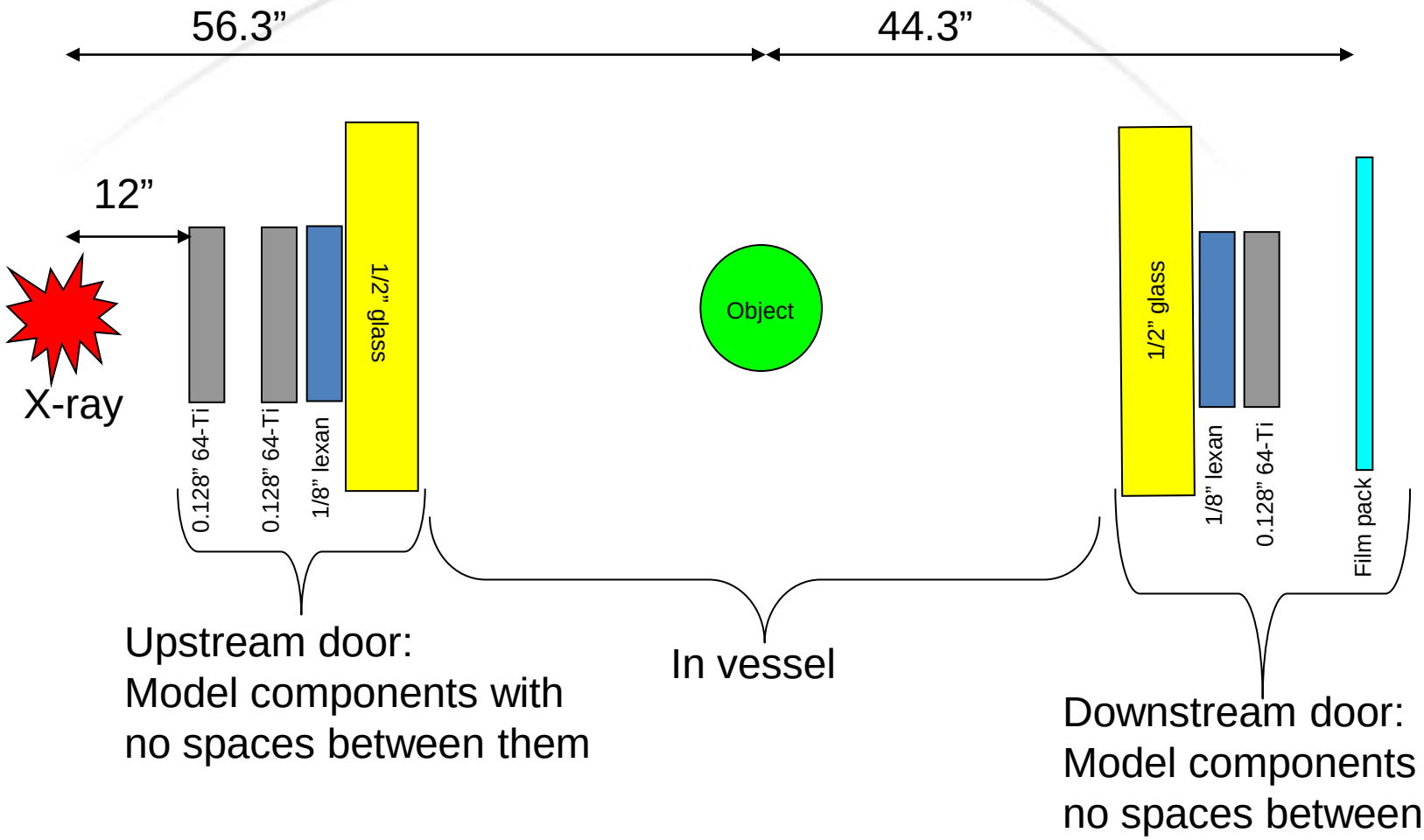
Mitigation for use on 6’ pRad vessel



Safety for Low Energy X-Rays

- Hazard Analysis
- Engineering Change Document
- Authorization Basis
- USI
- IWD
- Safety upgrades

Soft X-Rays

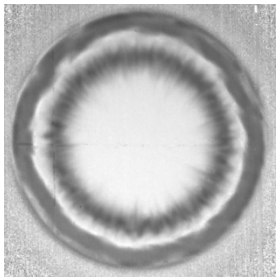
- 2013
  - PHELIX
    - Platts source
    - Success
  - Identified issues
    - Interference
    - Detector development
    - Pre-trigger
    - Shielding
  - Focus group
    - Met before the new year
    - Decided to revisit after the run-cycle

3 of 21 pRad images

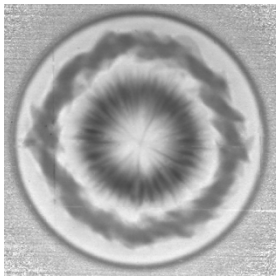
Target Cylinder

Times after current start

T = 30.0 µs



T = 34.0 µs



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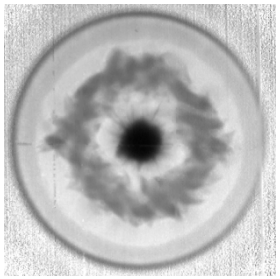
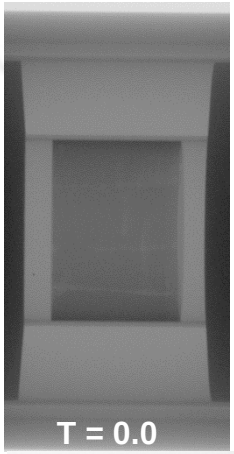
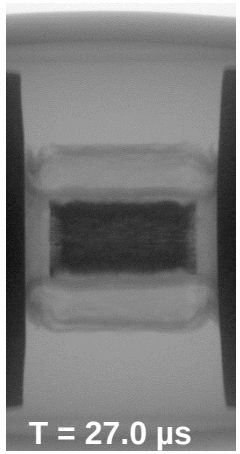


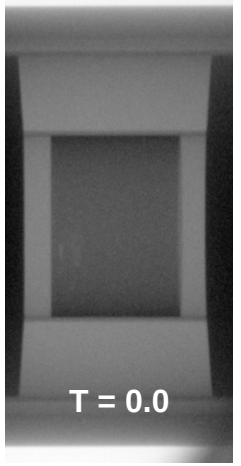
Transverse Flash X-Radiography

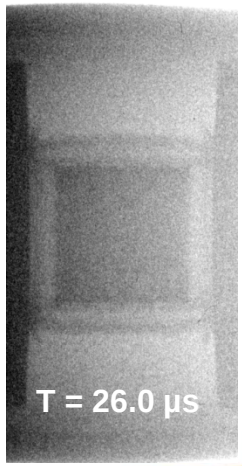
MPF-18





pRad





Soft X-Rays

- Why?
  - Orthogonal view
    - Ejecta experiments
      - Cloud mass, density, diffuse spray, jet interactions
    - Multi-dimensional modeling
    - Confirmation of systems
    - Reproducibility
      - Verifying rotational alignment creates the same result
  - Red Sage
    - Detector development
    - Vessel penetration
  - Off run cycle firing
    - Not reliant on the LANSCE accelerator to perform dynamic experiments
  - Experiment alignment
  - Implementation

For information about:

Future work at pRad

pRad capabilities and project information;
contact Andy Saunders, asaunders@lanl.gov

pRad scientific and radiography details;
contact Fesseha Mariam, fgm@lanl.gov

pRad operations and diagnostics;
contact Brian Hollander, brianh@lanl.gov

Student/Postdoc Opportunities Available

Contact Dale Tupa, tupa@lanl.gov

pRad User Program

The pRad user program, contact Frank Merrill, fmerrill@lanl.gov

A user program provides experimenters the opportunity to work at the 800 MeV LANL Proton Radiography facility at the Los Alamos Neutron Science Center. The facility can handle both unclassified and classified experiments. There is a yearly call for proposals for experiments. A Program Advisory Committee evaluates the proposals; beam time is allocated based on the recommendations of the committee.